JSC 63414

SPACECRAFT WATER EXPOSURE GUIDELINES

(SWEGs)

Toxicology Group
Environmental Factors Branch
Habitability & Environmental Factors Division

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National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

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REVISION LOG

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JSC-63414

SPACECRAFT WATER EXPOSURE GUIDELINES (SWEGs)

The National Aeronautics and Space Administration has determined that unique water exposure limits are required to protect astronaut health and, at the same time, not lead to over-design of water purification systems to meet unreasonably low standards. Based on guidance from the National Research Council Committee on Toxicology, Subcommittee on Spacecraft Water Exposure Guidelines (SWEGs, NRC, 2000) exposure guidelines have been set and documented for many of the compounds detected in the water systems of the Shuttle and International Space Station. The documentation for SWEGs is published by the National Academy Press in a series of volumes containing chapters that are authored by members of the JSC Toxicology Group (NRC, 2004). The guidelines consider the unique physiological changes that occur in space and the relatively robust nature of the astronaut corps. This publication is a tabular summary of the SWEGs documentation.

There are 2 groups of SWEGs that are set for each compound. Acute-exposure SWEGs are set for water consumptions of 1 and 10 days with the understanding that these limits apply only to contingency conditions. These acute-exposure guidelines allow for a moderate risk that the crew will experience mild dissatisfaction with the water, but not to the point where it would reduce their water consumption. There is only a slight risk that the compound could cause mild symptoms such as headache or nausea. Our goal in setting these limits is to help guide the management of a contingency event. These limits are not fully protective of crew health; therefore, they should never be used as design goals. The second group of SWEGs, for exposure periods of 100 or 1000 days, is set for prolonged consumption of water and allows for no appreciable risk to crew health. This includes the aesthetic properties of the water. Water that smells or tastes poor will reduce the consumption of water by the crew, and this condition cannot be accepted for long periods. Neither immediate toxic effects nor delayed (e.g. after the mission) toxic effects are acceptable. Combined effects of the compounds in drinking water are not considered.

More complete documentation of the SWEGs can be found on the Toxicology web page http://www.jsc.nasa.gov/toxicology/ . If a SWEG has not been established by the JSC Toxicology group on a specific compound, then the U.S. Environmental Protection Agency's (EPA) Maximum Contaminant Levels (MCL) can generally be used as an interim guide to safe water contamination http://www.epa.gov/safewater/mcl.html. Alternatively, JSC toxicologists can develop an interim SWEG when requested.

References

NRC (2000) Methods for Developing Spacecraft Water Exposure Guidelines. National Academy Press, Washington, D.C.

NRC (2004) Spacecraft Water Exposure Guidelines for Selected Contaminants, Volume 1, National Academy Press, Washington, D.C.

NRC (2006) Spacecraft Water Exposure Guidelines for Selected Contaminants, Volume 2, National Academy Press, Washington, D.C., in press

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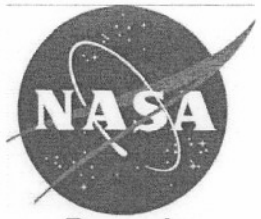
Spacecraft Water Exposure Guidelines*



Chemical Name	Potential Exposure Duration								Remarks
	1 day (mg/L)		10 days (mg/L)		100 days (mg/L)		1000 days (mg/L)		
Acetone	**3500**		**3500**		**150**		**15**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: 67641	Blood	Marrow	Blood	Macrocytic	Kidney	Nephropathy	Kidney	Nephropathy	
Year SWEG was Set/ Reviewed:2005					Spleen	Hemosiderin	Spleen	Hemosiderin	
Alkylamines (di)	**0.3**		**0.3**		**0.3**		**0.3**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: Variable	Nose	RWC	Nose	RWC	Nose	RWC	Nose	RWC	
Year SWEG was Set/ Reviewed:2004									
Alkylamines (mono)	**2**		**2**		**2**		**2**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: Variable	Nose	RWC	Nose	RWC	Nose	RWC	Nose	RWC	
Year SWEG was Set/ Reviewed:2004									
Alkylamines (tri)	**0.4**		**0.4**		**0.4**		**0.4**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: Variable	Nose	RWC	Nose	RWC	Nose	RWC	Nose	RWC	
Year SWEG was Set/ Reviewed:2004									
Ammonia	**5**		**1**		**1**		**1**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: 7664-41-7	Nose	RWC	Nose	RWC	Nose	RWC	Nose	RWC	
Year SWEG was Set/ Reviewed:2004									

* *See end of table for explanation of acronyms*

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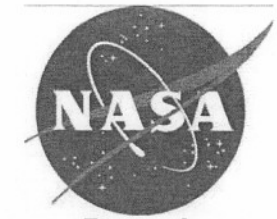

Chemical Name	Potential Exposure Duration								Remarks
	1 day (mg/L)		10 days (mg/L)		100 days (mg/L)		1000 days (mg/L)		
Barium (salts), soluble **Synonyms:** NRC Vol. #: 2 CAS #: variable Year SWEG was Set/ Reviewed:2005	**21**		**21**		**10**		**10**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	Heart	Cardiotoxicity	Heart	Cardiotoxicity		RWC		RWC	
Cadmium (salts), soluble **Synonyms:** NRC Vol. #: 2 CAS #: variable Year SWEG was Set/ Reviewed:2005	**1.6**		**0.7**		**0.6**		**0.022**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	G.I.	Emetic		RWC Taste	Bone	Osteotoxicity	Kidney	Nephrotoxicity	
Caprolactum **Synonyms:** 6-Aminocaproic acid NRC Vol. #: 2 CAS #: 105-60-2 Year SWEG was Set/ Reviewed:2005	**200**		**100**		**100**		**100**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	Liver	Hepatotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	
Chloroform **Synonyms:** NRC Vol. #: 1 CAS #: 67-66-3 Year SWEG was Set/ Reviewed:2004	**60**		**60**		**18**		**6.5**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
		RWC		RWC	Liver	Hepatotoxicity	Liver	Hepatotoxicity	
Di(2-ethylhexyl) phthalate **Synonyms:** DEHP NRC Vol. #: 1 CAS #: 117-81-7 Year SWEG was Set/ Reviewed:2004	**1800**		**1300**		**30**		**20**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	G.I.	Gastric Upset	Testes	Injury	Liver Testes	Hematotoxicity Injury	Testes	Injury	

* *See end of table for explanation of acronyms*

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Chemical Name	Potential Exposure Duration								Remarks
	1 day (mg/L)		10 days (mg/L)		100 days (mg/L)		1000 days (mg/L)		
Di-n-butyl phthalate **Synonyms:** DBP NRC Vol. #: 1 CAS #: 84-74-2 Year SWEG was Set/ Reviewed:2004	**1200**		**175**		**80**		**40**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	Testes	Injury	Testes	Injury	Blood	Hematotoxicity	Blood	Hematotoxicity	
Dichloromethane **Synonyms:** DCM NRC Vol. #: 1 CAS #: 75-09-02 Year SWEG was Set/ Reviewed:2004	**40**		**40**		**40**		**15**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	CNS	DCFF RWC	CNS	DCFF RWC	CNS Liver	DCFF Hepatotoxicity RWC	Liver	Hepatotoxicity	
Formaldehyde **Synonyms:** NRC Vol. #: 2 CAS #: 50-00-0 Year SWEG was Set/ Reviewed:2006	**20**		**20**		**12**		**12**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	G.I.	Gastric Upset	G.I.	Gastric Upset	G.I.	Gastric Upset	G.I.	Gastric Upset	
Formate **Synonyms:** NRC Vol. #: 2 CAS #: 64-19-7 Year SWEG was Set/ Reviewed:2005	**10,000**		**2500**		**2500**		**2500**		Decr. vision - decreased amplitude of electroretinograms
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	Eye	Decr. vision	Eye	Decr. vision	Eye	Decr. vision	Eye	Decr. vision	
Manganese (Salts), soluble **Synonyms:** NRC Vol. #: 2 CAS #: variable Year SWEG was Set/ Reviewed:2005	**14**		**5.4**		**1.8**		**0.3**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
		Systemic		Systemic	CNS		CNS		

* *See end of table for explanation of acronyms*

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POTENTIAL EXPOSURE DURATION

Chemical Name	1 day (mg/L)		10 days (mg/L)		100 days (mg/L)		1000 days (mg/L)		Remarks
2- Mercaptobenzothiazole **Synonyms:** MBT NRC Vol. #: 1 CAS #: 149-30-4 Year SWEG was Set/ Reviewed:2004	**200**		**30**		**30**		**30**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	CNS	Depression	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity	Kidney	Nephrotoxicity Cancer	
Nickel **Synonyms:** NRC Vol. #: 1 CAS #: 7440-02-0 Year SWEG was Set/ Reviewed:2004	**1.7**		**1.7**		**1.7**		**0.3**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	Bn Marrow	Immunosupres	Bn Marrow	Immunosupres	Bn Marrow	Immunosupres	Bn Marrow	Immunosupres	
Phenol **Synonyms:** Carbolic acid, phenic acid NRC Vol. #: 1 CAS #: 108-95-2 Year SWEG was Set/ Reviewed:2004	**80**		**8**		**4**		**4**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	G.I.	Irritation	G.I.	Irritation Taste	G.I.	Irritation Taste	G.I.	Irritation Taste	
n- Phenyl-beta-naphthylamine **Synonyms:** PBNA NRC Vol. #: 1 CAS #: Year SWEG was Set/ Reviewed:2004	**1600**		**1600**		**500**		**260**		
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
	G.I.	Toxicity	G.I.	Toxicity	Kidney	Lesions	Kidney	Lesions	
Silver **Synonyms:** Argentum NRC Vol. #: 1 CAS #: 7440-22-4 Year SWEG was Set/ Reviewed:2004	**5**		**5**		**0.6**		**0.4**		Argyria is not considered an adverse toxic effect. The 1000-d value is similar to levels suggested by WHO (1984) for lifetime exposure.
	Organ	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
		RWC		RWC		Hypoactivity		Argyria	

* *See end of table for explanation of acronyms*

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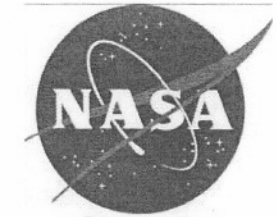

Chemical Name	POTENTIAL EXPOSURE DURATION								Remarks
	1 day (mg/L)		10 days (mg/L)		100 days (mg/L)		1000 days (mg/L)		
Total Organic Carbon	**Not Set**		**Not Set**		**3**		**Not Set**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: NA									
Year SWEG was Set/ Reviewed:2004									
Zinc, soluble compounds	**11**		**11**		**2.0**		**2.0**		
Synonyms:	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	*Organ*	*Effect*	
NRC Vol. #: 2 CAS #: variable		Immunotoxicity		Immunotoxicity	Blood	Hematotoxicity Immunotoxicity	Blood	Hematotoxicity	
Year SWEG was Set/ Reviewed:2005									

Acronyms:

CNS - Central Nervous System
DCFF - Decreased Critical Flicker Frequency
GI - Gastrointestinal System
NRC - National Research Council
N.S. - Not Set
PNS - Peripheral Nervous System
RBC - Red Blood Cells
RspSys - Respiratory System
RWC - Reduced Water Consumption

* *See end of table for explanation of acronyms*